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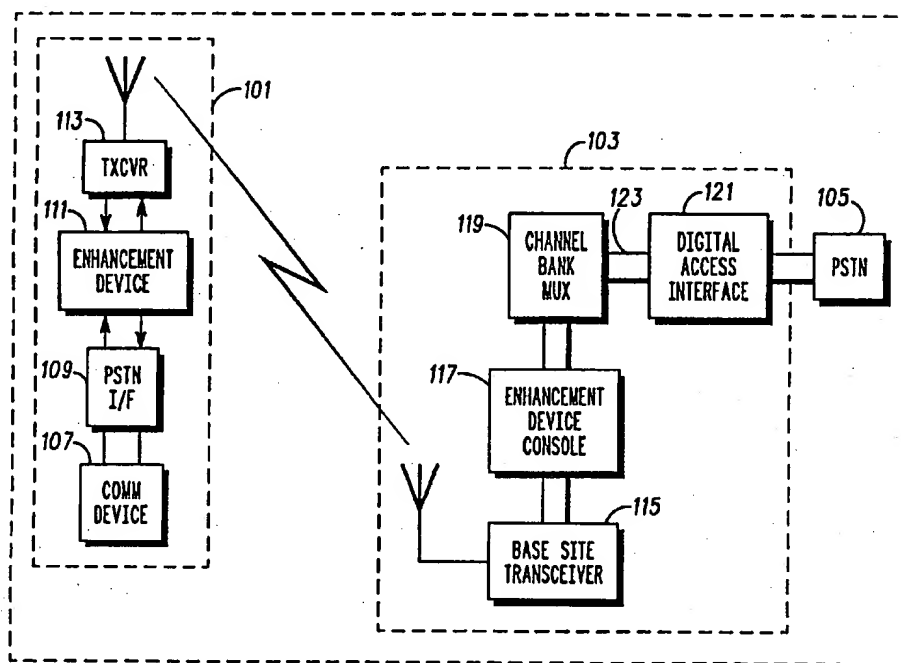
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(54) **ETABLISSEMENT D'UNE COMMUNICATION DANS UN
SYSTEME DE COMMUNICATIONS SANS FIL**

(54) **CALL SET-UP FOR FIXED WIRELESS COMMUNICATIONS
SYSTEM**

100



(57) Un système de communication fixe sans fil (100) est un système téléphonique à ligne fixe ou hybride et un système radiocellulaire hybride. Plus particulièrement, ce système téléphonique fixe sans fil (100) assure une liaison de communication instantanée entre un terminal fixe sans fil (101) d'un utilisateur et un système de communication à fil (105), ce qui permet à l'utilisateur de composer un autre numéro d'utilisateur et de recevoir des tonalités de progression d'appel telle que la tonalité d'invitation à numéroté. Cette liaison est établie par

(57) A fixed wireless communication system (100) is a hybrid of a fixed wire-line telephone system and a conventional cellular radio system. In particular, this fixed wireless telephone system (100) provides an instant communication link between a user's fixed wireless terminal (101) and a wire line communication system (105), allowing a user to dial another user's number as well as receive call progress tones such as the dial tone. This link is established by detecting (403) an off hook signal at the communication device,



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détection (403) d'un signal de décrochage au niveau du dispositif de communication, par transmission (405) d'une demande d'établissement de communication à numéro de téléphone "fantôme" sur le système cellulaire classique, et par la reconnaissance (411) dudit numéro "fantôme", par la demande (413), en réponse à ce dernier, d'une liaison audio sur le système de communication à fil (105) et par la liaison (415) de la liaison audio sur le système de communication à fil avec le dispositif de communication par le système de radiocommunication cellulaire classique.

transmitting (405) a call set-up request with a "ghost" telephone number over the conventional cellular system, and recognising (411) the "ghost" telephone number, requesting (413), responsive thereto, an audio link on the wire line communication system (105), and linking (415) the audio link on the wire line communication system with the first communication device over the conventional cellular radio communication system.

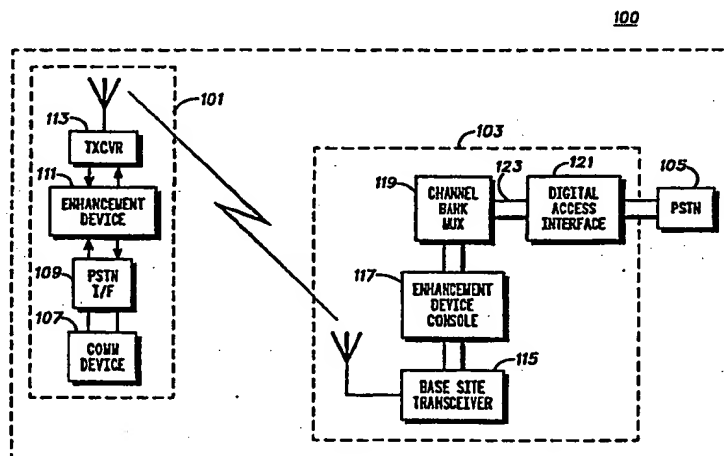


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(54) Title: CALL SET-UP FOR FIXED WIRELESS COMMUNICATIONS SYSTEM



(57) Abstract

A fixed wireless communication system (100) is a hybrid of a fixed wire-line telephone system and a conventional cellular radio system. In particular, this fixed wireless telephone system (100) provides an instant communication link between a user's fixed wireless terminal (101) and a wire line communication system (105), allowing a user to dial another user's number as well as receive call progress tones such as the dial tone. This link is established by detecting (403) an off hook signal at the communication device, transmitting (405) a call set-up request with a "ghost" telephone number over the conventional cellular system, and recognising (411) the "ghost" telephone number, requesting (413), responsive thereto, an audio link on the wire line communication system (105), and linking (415) the audio link on the wire line communication system with the first communication device over the conventional cellular radio communication system.

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CALL SET-UP FOR FIXED WIRELESS COMMUNICATIONS SYSTEM

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Field of the Invention

Generally, the present invention relates to communication systems and more particularly to a communication system including a radio communication system and a wire line communication system acting
10 as a fixed wireless communication system.

Background of the Invention

Generally, a fixed wireless telephone service is used as an alternative
15 to wire line telephone service in rural or urban settings, particularly in developing countries. One way of providing a fixed wireless telephone service is to use a conventional cellular telephone system and couple it with a wire line telephone system to provide wireless service to fixed terminals throughout a geographic area.

20

There are obvious differences between a conventional cellular telephone system and a conventional wire line telephone system. For example, in a wire line telephone system, upon detection of the off hook condition in the communication device an audio line is directly
25 coupled between a wire line telephone switch and the user's communication device. This audio line provides instant dialing services for the user and provides dial tone feedback to the user indicating service is available. In a conventional cellular system, a phone number is dialed and then an indicator or send button is
30 depressed to transmit a message indicating to a central base station that a call or communication is desired. After a certain amount of delay a communication channel is allocated to the user and is routed directly to the dialed number. No direct dialing on the communication channel is allowed and the system does not provide
35 dial tone feed back.

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In order to provide a fixed wireless telephone service, it is desirable to emulate the service of a fixed wire line telephone service.

Specifically, it would be advantageous to provide dial tone feedback and immediate connection to a telephone switch upon transmitting an off hook signal from a communication unit in a fixed wireless telephone system.

Summary of the Invention

A first aspect of the present invention provides a method of call setup for use in a communication system including a radio communication system and a wireline communication system, the method comprising the steps of detecting an off-hook condition at a first communication device; transmitting, responsive to said step of detecting, a predetermined digital bit stream using the radio communication system; recognizing the predetermined digital bit stream as a request for communication services; requesting, responsive to said step of recognizing, an audio link on the wireline communication system; and linking the audio link on the wireline communication system with the first communication device over the radio communication system, thereby forming a communication link between the first communication device and the wireline communication system allowing a user to dial a desired communication number.

A second aspect of the present invention provides a call setup apparatus for use in communication system including a radio communication system and a wireline communication system, the call setup apparatus comprising: a detector for detecting an off-hook signal at a first communication device; a radio transmitter, responsive to said detector, for transmitting a predetermined digital bit stream over the radio communication system; a radio receiver for receiving the predetermined digital bit stream; a controller comprising: means for recognizing the predetermined digital bit stream as a request for service; means, responsive to the means for

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recognizing, for requesting an audiolink on the wireline communication system, and linking the audiolink with the first communication device thereby allowing a user to dial a desired communication number.

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Brief Description of the Drawings

FIG. 1 is an illustration of a fixed wireless telephone service incorporating a conventional cellular telephone system and a conventional wire line telephone system in accordance with the present invention.

FIG. 2 is a detailed illustration in block diagram form of a base site inter-connection in accordance with the present invention.

FIG. 3 is an illustration in block diagram form of an enhancement device console in accordance with the present invention.

FIG. 4 is an illustration in process flow chart form of a call set up method in accordance with the present invention.

Detailed Description of a Preferred Embodiment

The preferred embodiment includes a description of a fixed wireless system that is a hybrid of a fixed wire-line telephone system and a conventional cellular radio system. It is intended as an alternative to wire line telephone system in rural or urban settings, particularly in developing countries. A fixed wireless telephone system saves the tremendous cost of providing the infrastructure required for a wire line telephone system and allows rapid installation of the service. In particular, this fixed wireless telephone system provides an instant communication link between a user's fixed wireless terminal and a wire line communication system, allowing a user to dial another user's number, as well as, receive call progress tones such as the dial

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tone. This link is established by detecting an off hook signal at the communication device, transmitting a call set up request with a "ghost" telephone number over the conventional cellular system, and detecting the ghost telephone number, requesting, responsive thereto, an audio link on the wire line communication system, and linking the audio link on the wire line communication system with the first communication device over the conventional cellular radio communication system. When modifying the conventional cellular system in the above manner, the user is provided with an instant link between the wire line communication system and a communication device in the fixed wireless telephone service, thus emulating a traditional wire line communication system.

FIG. 1 is an illustration of a fixed wireless communication system 100 including a fixed wireless terminal 101, a fixed wireless base station 103 and a conventional wire line switch 105. The fixed wireless terminal (FWT) 101 includes a traditional wire line communication device 107 such as a modem, a telephone or a fax machine. The fixed wireless terminal 101 additionally includes a PSTN interface 109, an enhancement device 111 and a cellular radio telephone transceiver 113.

The communication device 107 is any traditional wire line communication device such as a telephone, a fax machine or a modem. The communication device 107 is coupled to the PSTN interface via a traditional two-wire connection as is known in wire line communication systems. The PSTN interface 109 provides a traditional interface to a communication device such that the end user is not aware of any difference between a fixed wireless communication system and a fixed wire line communication system. Additionally, the PSTN interface detects traditional signalling created by the communication device 107, such as an off hook signal, an on hook signal and a switch hook signal. The PSTN interface 109 transmits the analogue audio between the communication device 107 and the enhancement device 111. Additionally, the PSTN interface

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109 transmits the detected standard communication device signals (on hook, off hook, switch hook) to the enhancement device 111 and communicates any standard wire line signals such as an incoming call signal, a metering pulse or an end of call signal from the enhancement device to the communication device 107.

The enhancement device 111 digitises the audio received from the PSTN interface 109 and transmits it to a standard cellular radio telephone system transceiver 113. Likewise, the audio received from the transceiver 113 is converted to analogue audio signals. Likewise, the enhancement device 111 converts the digital audio received from the transceiver 113 to analogue audio and is output to the PSTN interface 109. Additionally, the enhancement device 111 provides the necessary enhancement for operating the traditional cellular transceiver 113 in a fixed wireless telephone environment. Specifically, in response to receiving an original off hook signal from the PSTN interface 109, the enhancement device requests a communication channel on the conventional cellular radio communication system by transmitting a pre-determined digital sequence to the transceiver 113. In the preferred embodiment this predetermined digital sequence is a "ghost" telephone number. The specific details of this request are described below. Additionally, the enhancement device 111 codes and decodes traditional wire line signals, such as on hook, off hook, flash hook, metering pulse and end of communication signals.

The transceiver 113 is a standard cellular radio telephone system transceiver. In a preferred embodiment, the transceiver is developed to meet the TACS analogue cellular radio telephone system. However, it is envisioned that any other traditional cellular radio telephone communication system could be substituted therefor including analogue and digital cellular systems. The transceiver 113 transmits and receives radio frequency "RF" signals to and from a base site transceiver 115 located in the fixed wireless base station 103. The base site transceiver 115 is comparable with the radio

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transceiver 113 of the fixed wireless terminal 101. The base site transceiver 115 sends and receives digital audio signals to and from an enhancement device console 117. The enhancement device console 117 contains a plurality of enhancement devices earlier
5 described in relation to the fixed wireless terminal 101. Again, the enhancement devices 111 contained in the enhancement device console 117 digitise analogue audio signals transmitted there to pass those digital audio signals on to the base site transceiver 115. Likewise, the enhancement devices 111 contained within the
10 enhancement device console 117 transform received digital audio signals into audio signals for use in the traditional wire line telephone system. Additionally, the enhancement devices contained within the enhancement device console 117 code and decode the signals transmitted between enhancement device 111 of the fixed
15 wireless terminal and enhancement devices in the enhancement device console 117.

The channel bank multiplexer (MUX) 119 is coupled to a digital access interface (DAI) 121 via an E1 trunk 123. The digital access
20 interface 121 may be remotely located from the base site transceiver 115. In the preferred embodiment, the enhancement device console 117 and the channel bank MUX 119 are coupled using a microwave link. The channel bank MUX 119 converts audio received from the digital access interface 121 into four-way audio which is
25 then transmitted to the enhancement device console 117. Likewise, four-way audio received from the enhancement device console 117 is converted by the channel bank MUX 119 into one trunk and output to the digital access interface 121.

30 The digital access interface 121 provides a standard trunk level interface such as R2 or SAT, or a proprietary interface to the local central office switch. Thus, the DAI 121 interfaces between the E1 trunk 123 and the public switching telephone network 105. Additionally, the DAI 121 requests audio links on the wire line
35 communication system and links the audio link on the wire line

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communication system with a communication channel on the conventional cellular radio telephone system, thus providing a link between the communication device 107 and the PSTN 105.

5 FIG. 2 is a detailed illustration in block diagram form of a portion of the fixed wireless base station 103. Specifically, FIG. 2 includes the base site transceiver 115, the enhancement device console 117, the channel bank MUX 119, the E1 interface 123 and the interconnections between these devices. The base site transceiver
10 115 includes a transceiver 201 for each of the radio communication channels to a fixed wireless communication device such as FWT 101 of FIG. 1. It should be noted that the number of transceivers necessary will vary depending upon the cellular system utilised in this communication system 100. Specifically, if a time division
15 multiple access system is used, then each transceiver could service multiple fixed wireless telephony devices, thus, reducing the number of required transceivers. Each transceiver 201 of the base site transceiver 115 is coupled to the enhancement device console 117 via a four-wire connection 203. Each of the transceivers 201 are coupled
20 to an enhancement device 111 contained within the enhancement device console 117. In the preferred embodiment, up to 30 transceivers and 30 corresponding enhancement devices may be utilised. Each of the enhancement device 111 transmits a four-wire analogue audio signal to and from the channel bank MUX 119 via
25 lines 205. Additionally, the enhancement devices 111 code and decode the real time signalling bits which are used to transmit the traditional wire line signals such as on hook, off hook, flash hook, metering pulses and call termination via the real time signalling connections 207.

30 FIG. 3 is a detailed illustration in block diagram form of a enhancement device 111 of the present invention. The enhancement device includes a DSP 301, a first codec 303, a second codec 305, external memory 307, an interface connector 309, a first set of filters
35 311 related to the first codec 303 and a second set of filters 313

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related to the second codec 305. In the preferred embodiment, the DSP 301 is a 16 bit fixed point DSP operating at 80 megahertz (Mhz). For outgoing audio, the DSP 301 receives a string of binary numbers representing an analog audio signal. It converts this string to a digital stream that represents the actual data or voice received from the communication device 107 or from the PSTN 105. It then encodes the voice or data using the first code 303 or the second codec 305, filters the signals using the appropriate set of filters and transmits the encoded data/voice to the interface connector 309. For incoming audio, the DSP 301 performs decodes the data/voice digital signals, converting them back to an analog audio signal, reversing the outgoing audio process previously described. Additionally, the enhancement device 111, encodes and decodes the traditional telephony signals (on hook, off hook, switch hook, metering pulses, call disconnect) on to and off of the audio signals received by and transmitted from the enhancement device 111.

FIG. 4 is an illustration in process flow diagram form of a method 400 of call setup in accordance with the present invention. The method starts at 401. At function block 403, the PSTN interface 109 of FIG. 1 detects an off-hook condition at the communication device 107. At function block 405, the enhancement device 111 of FIG. 1 transmits, responsive to said step of detecting, a predetermined bit stream to the transceiver 113 for transmission on a control channel of the radio communication system. In the preferred embodiment, the predetermined bit stream is a "ghost" telephone number, as previously described. At function block 407, the fixed wireless base site 103 receives the predetermined bit stream. In response to receiving the predetermined bit stream, the fixed wireless base site 103 sets up a traffic channel for communication between the fixed wireless base site 103 and the communication device 107 at function block 409. The predetermined bit stream is then passed on to the DIA 121 within the fixed wireless base site 103. At function block 411, the DIA 121 recognises the predetermined digital bit stream as a request for communication services. At function block 413, the

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DIA 131 requests, responsive to said step of recognising, an audio link on the wireline communication system 105 of FIG. 1. The DIA 121 then links the audio link on the wireline communication system with the first communication device over the radio communication system, at function block 415. The communication device 107 then receives the dial tone from the wireline communication system, at function block 417, as it would in a wireline communication system. The user then dial a dual tone multi-frequency (DTMF) code to the wireline communication system over the traffic channel of the radio communication system, at function block 419. The method 400 ends at 421.

CLAIMS

1. A method of call setup for use in a communication system including a cellular radio communication system and a wireline communication system, the method comprising the steps of:
 - 5 detecting an off-hook condition at a first communication device;
 - 10 transmitting, responsive to said step of detecting, a predetermined telephone number using the cellular radio communication system;
 - recognizing the predetermined telephone number as a request for communication services;
 - 15 requesting, responsive to said step of recognizing, an audio link on the wireline communication system; and
 - linking the audio link on the wireline communication system with the first communication device over the cellular radio communication system, thereby forming a
 - 20 communication link between the first communication device and the wireline communication system allowing a user to dial a desired communication number.
2. The method of claim 1 further comprising the step of
- 25 retransmitting call progress tones and announcements generated by the wireline communication system to the first communication device.
3. The method of claim 2 wherein the call progress tones
- 30 include the dial tone.

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4. A call setup apparatus for use in communication system including a cellular radio communication system and a wireline communication system, the call setup apparatus comprising:

a detector for detecting an off-hook signal at a first

5 communication device;

a radio transmitter, responsive to said detector, for transmitting a predetermined telephone number over the cellular radio communication system;

a radio receiver for receiving the predetermined telephone

10 number;

an access device comprising:

means for recognizing the predetermined telephone number as a request for service;

means, responsive to the means for recognizing, for requesting an audiolink on the wireline communication

15 system, and

linking the audiolink with the first communication device thereby allowing a user to dial a desired communication number.

20

5. A call setup apparatus in accordance with claim 4 further comprising a second transmitter for retransmitting call progress tones and announcements generated by the wireline communication system to the first communication device via the cellular radio communication system.

25

6. The call setup apparatus of claim 5 wherein the call progress tones include the dial tone.

30

7. The call setup apparatus of claim 4 wherein the cellular radio communication system is an analogue cellular radio communication system.

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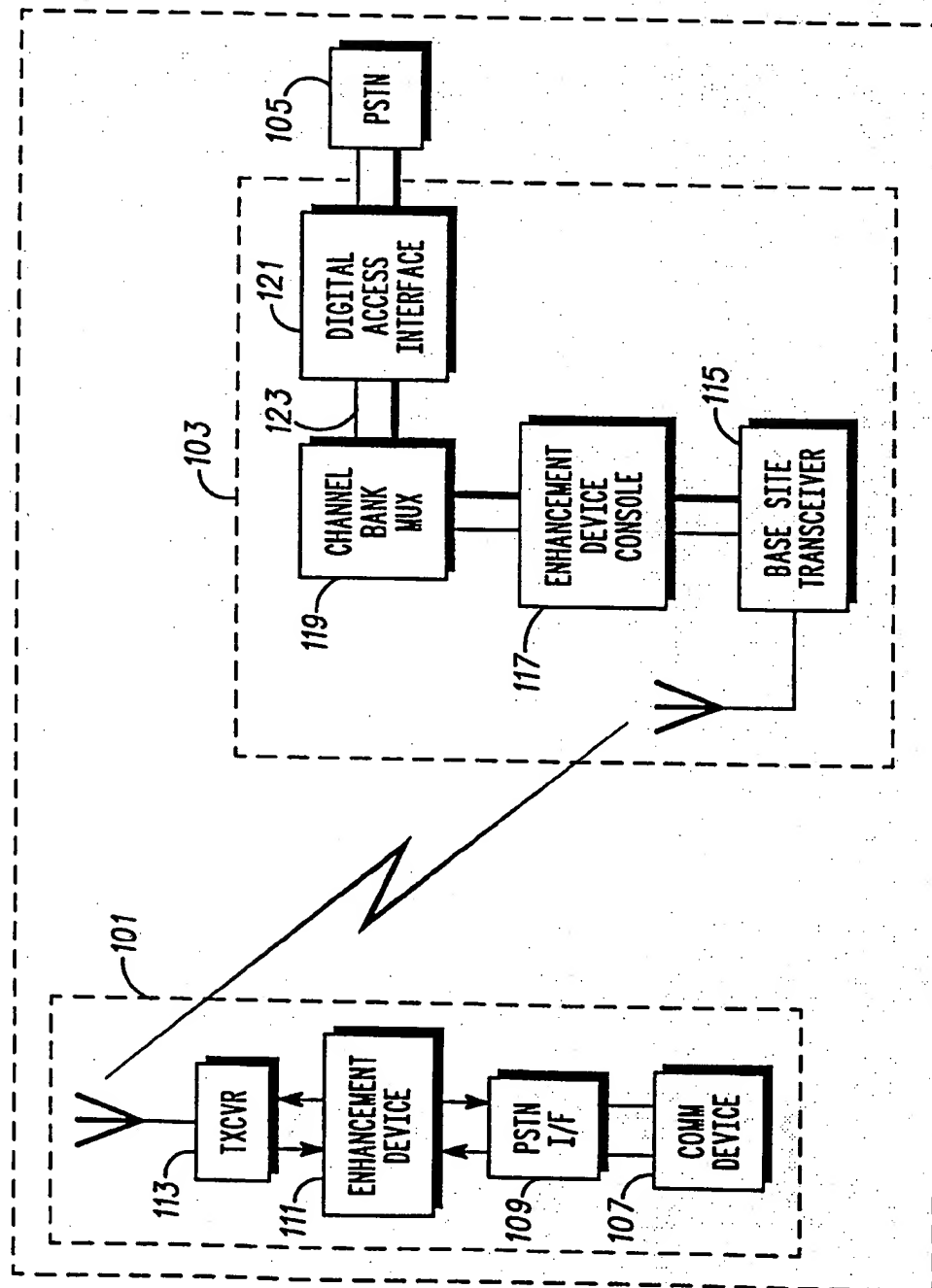
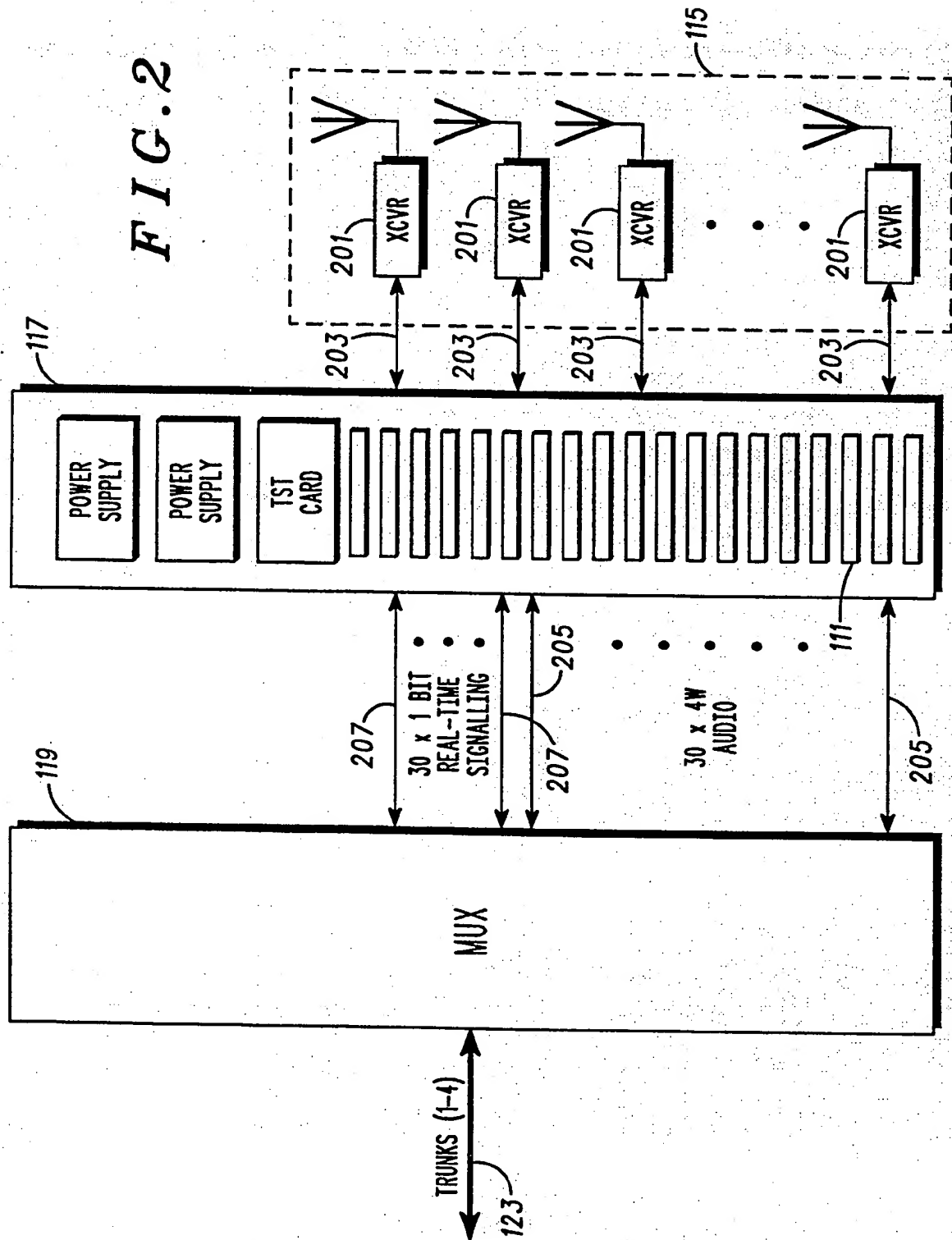
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FIG. 1

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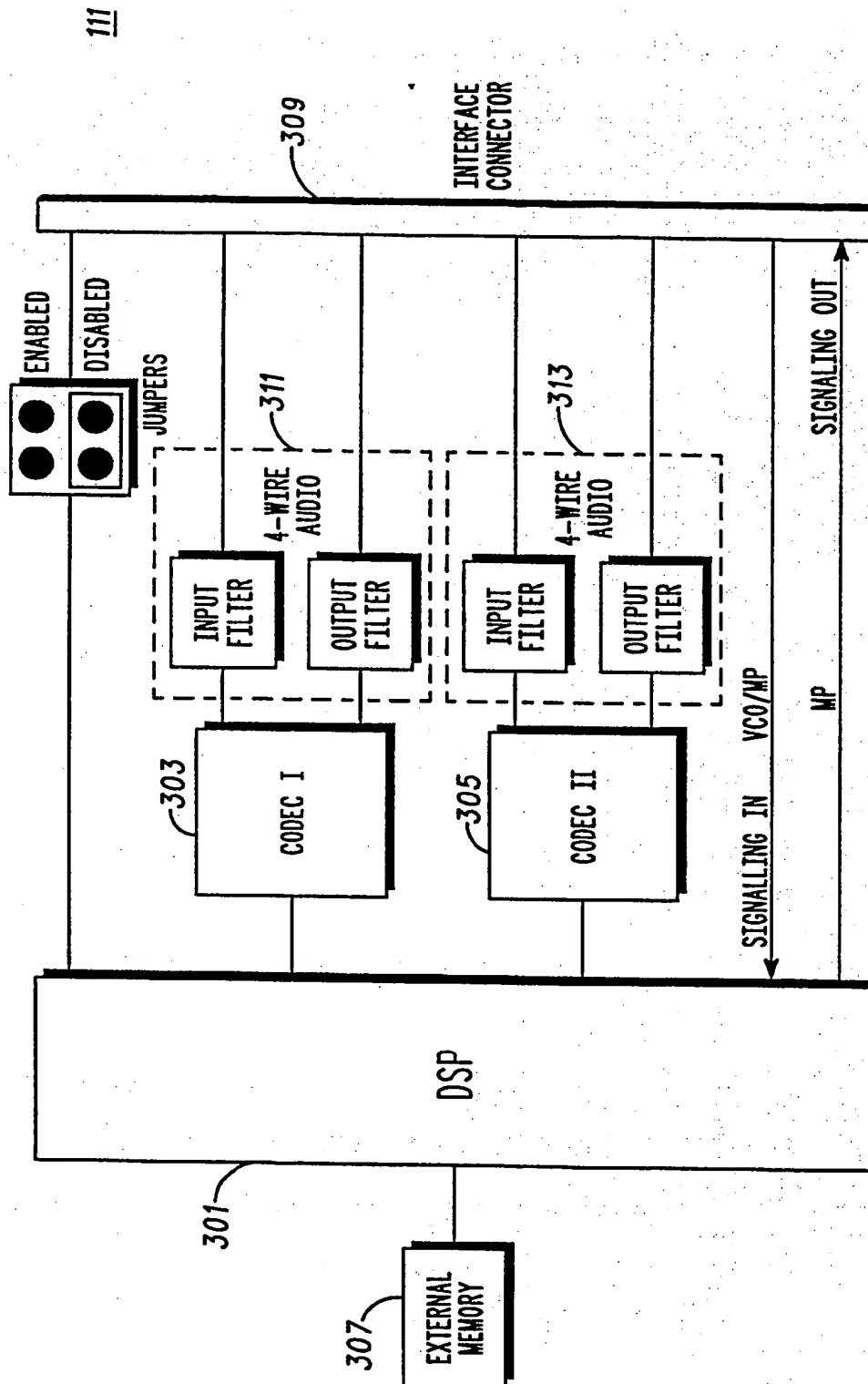


FIG. 3

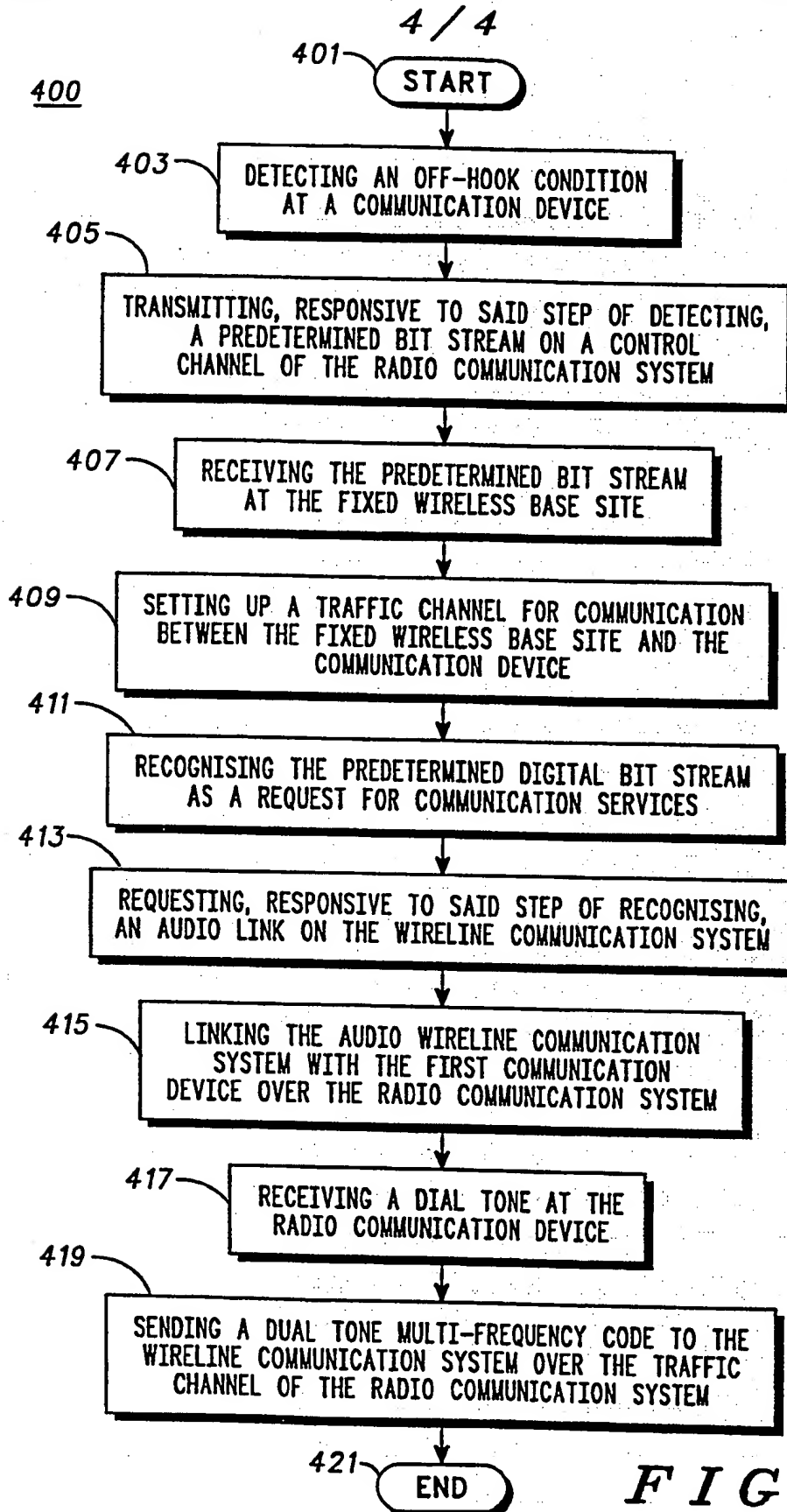


FIG. 4